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A New Bison from the Pleistocene of Kansas, With Notice of a New Locality for *Bison occidentalis*.

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IN the summer of 1909, while excavating for road-building material near Garden City, Finney county, Kansas, some workmen found the following-described remains of a new species of bison in the sand hills on the south side of the Arkansas river. The specimen was later secured by Mr. A. F. Osbun, of Garden City, who in 1910 forwarded it to the University of Kansas for identification. On learning of its scientific value he generously donated it to the museum of Kansas University.

Bison willistoni Martin, n. sp.

TYPE—No. 390, Department of Vertebrate Paleontology, University of Kansas Museum of Natural History. This specimen consists of a perfect left horn core, and a small portion of the left maxillary, in which is imbedded a part of the last upper molar. (Plate XXVI, Fig. 1; and Plate XXVII, Figs. 3, 3*a*.)

TYPE LOCALITY. South side of the Arkansas river, near Garden City, Finney county, Kansas, near north latitude 38° and west longitude 101°.

HORIZON. The specimen, according to information furnished by Mr. Osbun, was found at a depth of seven or eight feet below the surrounding prairie, in what was said to be a layer of "gyp" or mortar-bed formation—a sandy gravel held together by lime carbonate. Extensive exposures of these beds occur in the locality, particularly on the north side of the river, from a point just below Garden City to a distance of some twenty miles down the stream.

It is probable that the sand pit from which the specimen was obtained is located in a deposit of middle Pleistocene age, material from earlier mortarbed material (Tertiary) having been washed to this place as indicated in part by the presence of other bones associated with those of the bison. While at the time of discovery a number of these bones, including several teeth, were found in the pit, much of this material was later lost. Upon request, however, Mr. Osbun was able to secure some of the other bones and forwarded them to the museum. Among the material thus secured is a portion of a tooth of *Elephas primigenius,* a form very prevalent in the Kansas Pleistocene, and a lower premolar of a horse, which is very similar to *Equus excelsus.* The nature of the find, together with the data at hand, does not reveal a very close similarity to the conditions in the case of the *Bison occidentalis* found in Logan county, some eighty miles farther north. There appears to be a greater degree of petrifaction in the bones of *Bison willistoni* than in *Bison occidentalis*—a condition which should no doubt be attributed to a different and an earlier deposition of the layer in which the remains were found. There can be no doubt but that they represent an earlier Pleistocene fauna.

The new species here described and figured is named *Bison willistoni,* in honor of our late friend, the eminent student of vertebrate paleontology, Dr. S. W. Williston.

THE HORN CORE.

It is unfortunate that more of the skull was not preserved with the horn core. The small fragment of the maxillary, with portions of the molar still imbedded within it, indicates, however, thicker walls and a much more heavily built skull than any yet dscribed, and must represent an animal much larger and more robust than was *Bison occidentalis,* probably its nearest relative.

According to the classification proposed by F. A. Lucas[1] for American fossil bisons, *Bison willistoni* belongs to the group containing *B. occidentalis, B. kansensis* and *B. bison,* but it can be distinguished from any of these forms by the greater circumference of the horn core, and the more sharply upward curve of its distal fourth. The base of the horn core of *B. willistoni* does not sag, but, instead, rises in a gentle curve from the level of the skull for about three-fourths of its length, from which point it curves sharply to its tip, which terminates more obtusely than does that of *B. occidentalis.* (Compare Figs. 1 and 2, Plate XXVI.) In the following measure-

1. "The Fossil Bison of North America," Proc. of the U. S. National Museum, vol. XXI, pages 755-771. 1899.

ments, notice should be particularly directed to those of the transverse and vertical diameters of the horn core, which indicate that in *B. willistoni* the core is more flattened vertically along its whole length than is the case in *B. occidentalis*, the distal third of the latter being cylindrical in shape. McClung[2] gives the following measurements of the horn core in the other three species included in this group, to which are added the corresponding data for *B. willistoni*. All of these measurements were taken from specimens in the collection of the University of Kansas museum, and are given in millimeters.

	B. willistoni.	*B. occidentalis.*	*B. kansensis.*	*B. bison.*
Circumference at base	415 mm.	343 mm.	290 mm.	253 mm.
Vertical diameter at base	130	108	90	76
Transverse diameter at base	147	108	97	81
Length of upper curve	460	318	250 (est.)	180
Length of lower curve	560	372	265 (est.)	235

It is seen here that the horn core in *B. willistoni* is greater in all its dimensions than any of the other three; but whereas in *B. occidentalis* the vertical and transverse diameters at the base are identical, in *B. willistoni* the transverse diameter is 17 millimeters greater than the vertical, indicating the flattening already referred to as distinguishing this form from *B. occidentalis*. A similar flattening occurs in *B. kansensis* and *B. bison*, though in the former species the degree of flattening is relatively less, and in the latter relatively more than in *B. willistoni*. The basal circumference is 72 millimeters greater in *B. willistoni* than in *B. occidentalis*, which stands next to it in size, and the length along both the upper and lower curves is 142 and 88 millimeters, respectively, to the advantage of the former.

THE MAXILLARY AND LAST LEFT UPPER MOLAR.

Figures 3 and 3*a*, Plate XXVII, show the crown and inner side views, natural size, of the maxillary fragment and the last upper molar in place, from the left side of *B. willistoni*. The grinding surface of the part of the tooth preserved is well worn down, giving evidence of having belonged to a very old individual. This wearing down of the crown is especially well marked in the hinder lobe of this tooth, from which the following measurements have been made:

Estimated length of grinding surface	45 mm.
Actual width across the posterior lobe	32

2. "The Fossil Bison of Kansas," paper read before the Kansas Academy of Science, December 3, 1904.

Measurements of the corresponding tooth of *B. occidentalis* are as follows:

Length of grinding surface	33 mm.
Width of grinding surface	25

These dimensions indicate a tooth size between one-fourth and one-third larger in *B. willistoni* than in *B. occidentalis.*

SECOND UPPER LEFT MOLAR.

Among the specimens submitted by Mr. Osbun is a bison tooth (catalogue number 391) found in a sand pit on the north side of Arkansas river, directly opposite the place where the other described remains were found. This is the second upper molar from the left side of a younger individual. Its size, as well as the pattern of the enamel folds, remove it from *B. occidentalis,* which form it most nearly resembles. Unless later finds should indicate that it represents another distinct species, I would identify this as belonging to a young individual of *B. willistoni.* This tooth is shown on Plate XXVII, Figures 4 and 4*a*, the former a crown view, the latter a side view. Of this tooth the following measurements have been made:

From the base of the tooth to the level of the crest	70 mm.
Extreme length of grinding surface of crown	40
Width across posterior lobe of grinding surface	30

Corresponding measurements of the same tooth of *B. occidentalis:*

From base of the tooth to level of the crest Est	52 mm.
Extreme length of grinding surface of crown	32
Width across posterior lobe of grinding surface	22

Figures 5, 5*a*, 6 and 6*a*, Plate XXVII, give crown and mesial views of the second upper molar of *B. occidentalis* and *B. bison,* respectively, for comparison. Attention should be directed particularly to the relative size of these teeth, which form a well-graded series from *B. willistoni,* the largest, to *B. bison,* the smallest. While the enamel pattern of the crown is in general the same in all, yet sufficient differences in detail are noticeable to make them specifically distinct. The relative size and the shape of the metastyl, mesostyl and parastyl are distinctly different in each case, as well as the secondary crochets between them. The metacone and paracone likewise show similar variations. The metaloph is marked by a decided crochet. The hypocone and protoconule are lacking in the other two species, while the crochet is apparently wanting in all. These also show differences in form, though less marked than in the other portions just mentioned.

Perhaps the greatest dissimilarity is displayed by the protocone, which in fact affords an easy means of identification. In *B. willistoni* the protocone is very large and lies in a large reëntrant angle between the hypocone and the protocone, while the whole contour of the protocone is conspicuously tortuous. In side view the protocone forms a long fluted pillar extending quite to the base of the tooth. In *B. occidentalis* it is not only shorter, but lacks the vertical groove on its exposed surface. In *B. bison* a corresponding groove is present, but shallower, and the whole structure ends at approximately the lower level of the crown of the tooth. In short, the protocone differs so decidedly in each of these three cases as to leave no doubt of the specific distinction of the three forms represented.

I here wish to express my thanks and appreciation to Dr. H. H. Lane for his assistance and advice in the final arrangement of this paper.

A NEW LOCALITY FOR BISON OCCIDENTALIS.

In the fall of 1921, Professor Landrum, then superintendent of the high school at Atwood, Rawlins county, Kansas, called my attention to a deposit of "old bones" which he said were washed out and exposed in great numbers on the east bank of a small stream called Burntwood creek, about nine miles north of McDonald, three miles east of the line between Rawlins and Cheyenne counties, and forty miles east of the Kansas-Colorado state line.

While attending the University here, Professor Landrum assisted me in the paleontological laboratory, so when he assured me the bones were not of any modern animal, but crumbled easily, and were very brittle, I concluded that the exposure was well worth investigating.

The following July, accompanied by two students, Raymond Hall and Neil Thornburg, I had opportunity to visit the bone bed, when on our way to the Hays Springs fossil quarry at Agate, Neb. As our time in Rawlins county was limited to ten days, five were spent in an examination of the exposures around Atwood and five in actual work in the quarry. This did not allow any extensive excavating, but enough was cleared to show that this deposit constitutes the most extensive and richest deposit of Pleistocene fossils so far reported from Kansas. A good representative collection was secured, including three skulls, many limb bones, and innumerable teeth.

The deposit shows a heterogeneous accumulation of many animals, with little association of skeletal parts, and in only two or three instances were vertebræ and skulls found connected, or parts of the limb bones in position. Teeth seemed to be scattered throughout the whole bed, and the skulls have in most cases disintegrated. The proximal ends of humeri and femora are nearly always badly broken up, and few pelvic bones are sound enough to remove, even with the help of shellac as a hardener.

Mr. George Hufman, who owns the property on which the bone bed is located, visited us frequently, and generously invited us to collect all the material, so the following year (1923) I revisited the locality with two students, Mr. D. H. Sprong, Jr., and Neil Coleman, as assistants. During this trip to the quarry a great amount of material was secured, but no complete skeleton was found. Many very fine complete lower limbs were gathered, both back and front, but few perfect femora, scapulæ or humeri could be found.

Two fine skulls were shipped *en bloc,* the horn cores and teeth of which represent typical *Bison occidentalis,* and I have no hesitancy in ascribing the whole herd to that species.

The deposit was first noticed some thirty-eight years ago by Mr. Lily, of Atwood, who then resided on a farm close by, and who tells me it was known locally as Bone Hill. At that time the face of the wall formed by the bones was nearly perpendicular and from ten to twelve feet high and twenty feet long. To-day it shows a sloping front with a width of twenty-five feet, extending clear back to the older Republican beds, and has a length of seventy-five feet. There appears to have been a general disturbance of the material after its first deposition, due probably to the effects of water from the Burntwood, which now meanders at the base of the deposit, but some twenty feet below.

The deposit is situated at the base of an abrupt escarpment composed of the Republican beds, which extends here in a straight north-and-south line for a distance of two miles or more, with a height of thirty-five to forty feet.

The number of animals that perished here could not have been less than 150, while scattering bones outcrop on the same level for a distance of half a mile downstream.

The deposit is not yet exhausted, and further work will be continued as time and opportunity admits.

PLATE XXVI.

FIG. 1. Horn core of *Bison willistoni,* not quite one-third natural size.
FIG. 2. Horn core of *Bison occidentalis,* not quite one-third natural size.

PLATE XXVI.

PLATE XXVII.

FIG. 3. Crown view of remnant of the last upper molar of *Bison willistoni*, with portions of the maxillary.

FIG. 3*a*. Lateral view of the same tooth.

FIG. 4. Crown view of the second upper molar, provisionally assigned to a young individual of *Bison willistoni*.

FIG. 4*a*. Lateral view of the same tooth.

FIG. 5. Crown view of the second upper molar of *Bison occidentalis*.

FIG. 5*a*. Lateral view of the same tooth.

FIG. 6. Crown view of the second upper molar of *Bison bison*.

FIG. 6*a*. Lateral view of the same tooth.

PLATE XXVII.